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TECHNICAL MEMORANDUM

title: HIGH CURRENT BUS BAR TEST REPORT
(Supplement to TRIESTE II Bus Bar Report)

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HIGH CURRENT BUS BAR TEST REPORT
(Supplement to TRIESTE II Bus Bar Report 75-L43-R8)

INTRODUCTION

Two experimental quick-disconnect bus bars for the TRIESTE II 24-volt silver-zinc battery were tested at high current rates and evaluated for temperature rise, contact resistance characteristics, and fault current effects. The high normal operating current on the TRIESTE II submersible is 300 amperes. Full load capability is 493 amperes and the circuit breakers trip at 630 amperes.

The two bus bars were previously tested under pressure to 11,000 psi for electrical and sealing characteristics (see TRIESTE II Bus Bar Test Report 75-L43-R8 of 13 November 1975). At that time, tests revealed an average contact resistance of 3.6×10^{-5} ohms at 100 amperes with variation of less than 3 percent.

TEST PROCEDURES AND RESULTS

The hypalon-insulated copper bus bars were mounted on the test stand with silver-plated louvered washers between the bus bars and experimental terminal posts. The brass bolts which attach the bus bars to the posts were secured tightly and the test platform was submerged in mineral oil. Thermocouple wires were placed next to the contact area underneath the hypalon insulation to record temperature (see Figure 1 schematic diagram).

Four silver-zinc cells from the TRIESTE II 24-volt battery were used as the power source to generate currents up to 1200 amperes. Various current rates were induced through the bus bars and voltage drop (to determine contact resistance) and temperature measurements were recorded. When the temperature of the contact area stabilized, the current was increased up to a maximum of 1200 amperes DC. Results are summarized in Table I.

Table I

Current (Amperes)	Average Voltage Drop Across Bus Bar	Average Contact Resistance Per Bus Bar	Equivalent Voltage Drop Across on Entire Bus Bar	Maximum Temperature Increase of Bus Bar in Oil	Oil Temperature
100	3.3 mv	3.3×10^{-5} ohms	0.053 V.	-	-
300	9.7 mv	3.23×10^{-5}	0.155 V.	1°F	66
500	16.4 mv	3.28×10^{-5}	0.26 V.	10°F	72
600	19.7 mv	3.28×10^{-5}	0.315 V.	9°F	64
1200	39.5 mv	3.29×10^{-5}	0.63 V.	28°F*	79

*The maximum temperature measured during this test series was 108°F.

To test the bus bars for effects of surge (fault) currents, a multi-amp circuit breaker test unit was used to generate up to 12,000 amperes of AC current for one second. Although the bus bars would normally have DC current flowing through it, an AC current of 12,000 amperes RMS has the equivalent DC current heating and voltage drop effects. A current magnitude of 10,000 amps AC was applied for seven seconds to study heat generation. The bus bars were in air at approximately 70°F during these tests. Results are summarized in Table II.

Table II. Fault Current Test (two bus bars in air at 70°F)

	Elapsed Time	Maximum Temperature
8,000 amp at 3V. AC	3 seconds	80°F
10,000 amp at 6V. AC	7 seconds	132°F
12,000 amp at 6V. AC	1 second	100°F

DISCUSSION

The contact resistance varied by about 2 percent over the current range of 0 to 1200 amperes DC. The maximum temperature recorded was 108°F after one hour of 1200 amperes DC. The highest oil temperature recorded in the vicinity of the bus bar was 79°F. There was no visible damage to the bus bar or louvered washers.

During the fault current test, the maximum temperature of the bus bar was 132°F. This temperature was recorded after seven seconds at 10,000 amperes and 6 volts AC.

There was no visible damage or change in the performance to the bus bars or louvered washers throughout the entire test series. The bus bars would never experience currents of this magnitude (for seven seconds or more) because fuses or circuit breakers would interrupt the current.

CONCLUSION

The high current rate and fault current test results have verified that the TRIESTE II experimental bus bars can withstand the normal operating currents and potential fault currents of the TRIESTE 24-volt battery. Continuous current rates up to 1200 amperes and fault currents at 12,000 amperes for a few seconds will not cause the bus bars to overheat or fail.

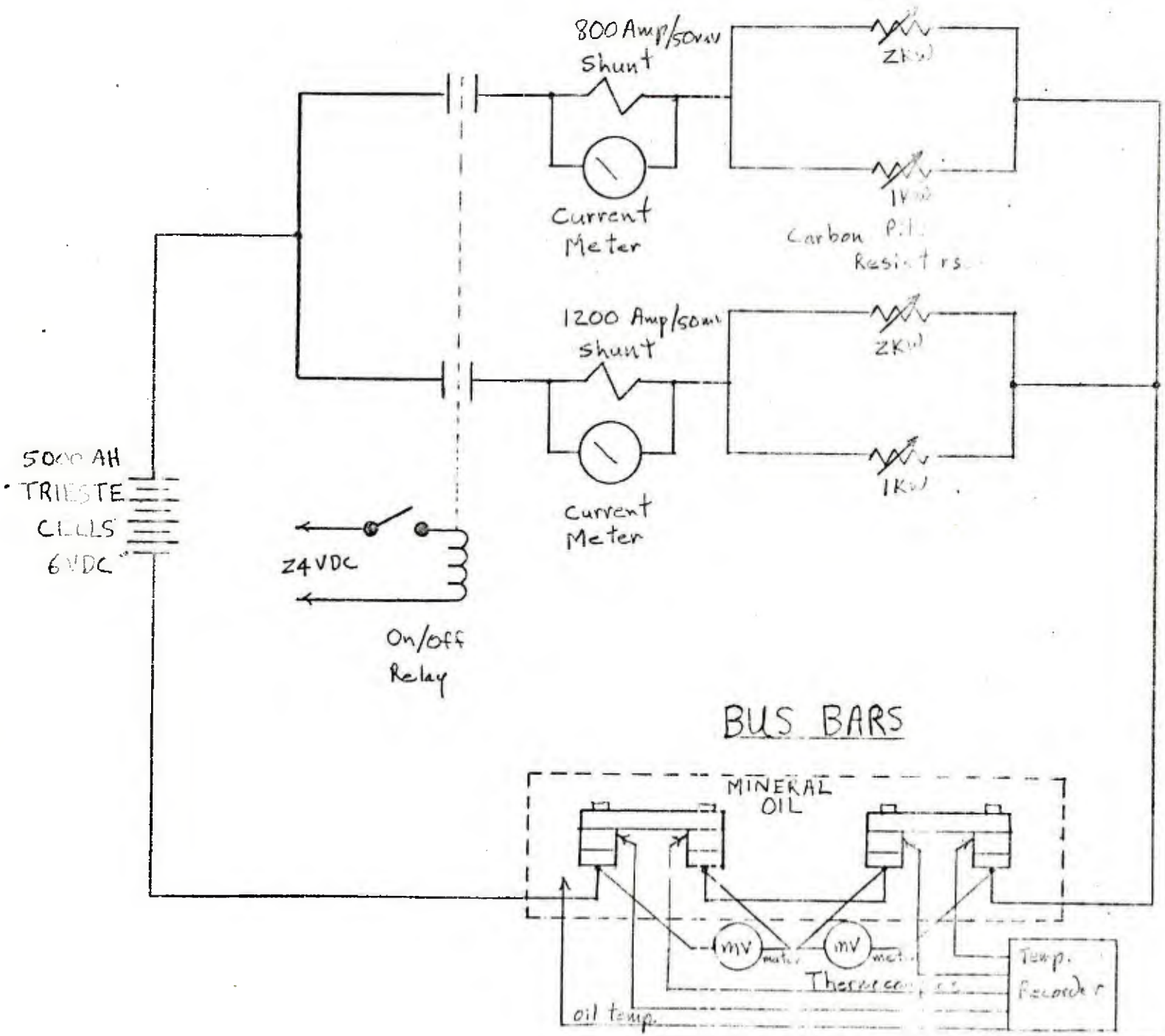

Figure 1

Schematic Diagram of Trieste Bus Bar Power Test